WIDE BAND AGC AMPLIFIER GaAs MMIC

GENERAL DESCRIPTION
NJG1101F is a GaAs MMIC designed mainly for wireless phone handsets at frequency range of 850MHz from 2.5GHz. NJG1101F is a variable gain amplifier with 40 dB dynamic range and exhibits low current consumption. MTP6 package is adopted.

FEATURES
- Single and low voltage operation
- Low current consumption
- Small signal gain
- Wide gain control range
- Pout at 1dB gain compression point
- Package

VDD=+3.0V typ.
IDD=10mA typ.
18dB typ. @f=1.5GHz
(f=0.85~2.5GHz @3dB down)
40dB typ. @VCONT=+0.1~+2.0V
+1.5dBm typ. @f=1.5GHz
MTP6 (Mount Size: 2.8 x 2.9 x 1.2mm)

PIN CONFIGURATION

Note: □ is a package orientation mark.
### ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>RATINGS</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain Voltage V&lt;sub&gt;DD&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>6</td>
<td>V</td>
</tr>
<tr>
<td>Gain Control Voltage V&lt;sub&gt;CONT&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3V</td>
<td></td>
<td>3</td>
<td>V</td>
</tr>
<tr>
<td>Input Power P&lt;sub&gt;in&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3V, V&lt;sub&gt;CONT&lt;/sub&gt;=2V</td>
<td></td>
<td>10</td>
<td>dBm</td>
</tr>
<tr>
<td>Power Dissipation P&lt;sub&gt;D&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>300</td>
<td>mW</td>
</tr>
<tr>
<td>Operating Temperature T&lt;sub&gt;opr&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>-40~+85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature T&lt;sub&gt;stg&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>-55~+150</td>
<td>°C</td>
</tr>
</tbody>
</table>

### ELECTRICAL CHARACTERISTICS

(Wide band: Measured at TEST CIRCUIT 1) *(T<sub>a</sub>=+25°C, Z<sub>s</sub>=Z<sub>l</sub>=50Ω)*

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Frequency freq</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3.0V</td>
<td></td>
<td>0.85</td>
<td>1.5</td>
<td>2.5</td>
<td>GHz</td>
</tr>
<tr>
<td>Drain Voltage V&lt;sub&gt;DD&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>2.7</td>
<td>3.0</td>
<td>5.0</td>
<td>V</td>
</tr>
<tr>
<td>Operating Current I&lt;sub&gt;DD&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3.0V, V&lt;sub&gt;CONT&lt;/sub&gt;=2V, P&lt;sub&gt;out&lt;/sub&gt;=-10dBm</td>
<td>-</td>
<td>10</td>
<td>13</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Small Signal Gain Gain</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3.0V, V&lt;sub&gt;CONT&lt;/sub&gt;=2V, P&lt;sub&gt;out&lt;/sub&gt;=-10dBm, f=1.5GHz</td>
<td>15.5</td>
<td>18</td>
<td>21</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Gain Flatness G&lt;sub&gt;flat&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3.0V, V&lt;sub&gt;CONT&lt;/sub&gt;=2V, P&lt;sub&gt;out&lt;/sub&gt;=-10dBm, f=0.85~2.5GHz</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Gain Control Range G&lt;sub&gt;cont&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3.0V, V&lt;sub&gt;CONT&lt;/sub&gt;=0.1~2.0V, P&lt;sub&gt;in&lt;/sub&gt;=-25dBm, f=1.5GHz</td>
<td>35</td>
<td>40</td>
<td>-</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>P&lt;sub&gt;out&lt;/sub&gt; at 1dB Gain Compression point P&lt;sub&gt;-1dB&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3.0V, V&lt;sub&gt;CONT&lt;/sub&gt;=2V, f=1.5GHz</td>
<td>-</td>
<td>+1.5</td>
<td>-</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Adjacent Channel Leakage Power (PDC Regulation) P&lt;sub&gt;acp&lt;/sub&gt;</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;=3.0V, V&lt;sub&gt;CONT&lt;/sub&gt;=2V, P&lt;sub&gt;out&lt;/sub&gt;=-10dBm, f=1.5GHz, Offset=50kHz, P&lt;sub&gt;in&lt;/sub&gt;; π/4 DQPSK</td>
<td>-</td>
<td>-68</td>
<td>-</td>
<td>dBc</td>
<td></td>
</tr>
</tbody>
</table>
### ELECTRICAL CHARACTERISTICS 2 (800MHz Band: Measured at TEST CIRCUIT 2)

\( T_a=25^\circ C, \ Z_s=Z_l=50\Omega \)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Frequency</td>
<td>freq</td>
<td>( V_{DD}=3.0V )</td>
<td>850</td>
<td>938</td>
<td>960</td>
<td>MHz</td>
</tr>
<tr>
<td>Drain Voltage</td>
<td>( V_{DD} )</td>
<td></td>
<td>2.7</td>
<td>3.0</td>
<td>5.0</td>
<td>V</td>
</tr>
<tr>
<td>Operating Current</td>
<td>( I_{DD} )</td>
<td>( V_{DD}=3.0V, V_{CONT}=2V, ) ( P_{out}=-10dBm )</td>
<td>-</td>
<td>10</td>
<td>13</td>
<td>mA</td>
</tr>
<tr>
<td>Small Signal Gain</td>
<td>Gain</td>
<td>( V_{DD}=3.0V, V_{CONT}=2V, ) ( P_{out}=-10dBm, f=1.5GHz )</td>
<td>15.5</td>
<td>18</td>
<td>21</td>
<td>dB</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>( G_{flat} )</td>
<td>( V_{DD}=3.0V, V_{CONT}=2V, ) ( P_{in}=-25dBm, f=0.85~2.5GHz )</td>
<td>-</td>
<td>0.5</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Gain Control Range</td>
<td>( G_{cont} )</td>
<td>( V_{DD}=3.0V, V_{CONT}=0.1~2.0V, ) ( P_{in}=-25dBm, f=1.5GHz )</td>
<td>35</td>
<td>40</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Pout at 1dB Gain Compression point</td>
<td>( P_{-1dB} )</td>
<td>( V_{DD}=3.0V, V_{CONT}=2V, f=1.5GHz )</td>
<td>-</td>
<td>+1.5</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>Adjacent Channel Leakage Power (PDC Regulation)</td>
<td>( P_{acp} )</td>
<td>( V_{DD}=3.0V, V_{CONT}=2V, ) ( P_{out}=-10dBm, f=1.5GHz ) ( offset=50kHz, P_o; \pi/4 DQPSK )</td>
<td>-</td>
<td>-68</td>
<td>-</td>
<td>dBc</td>
</tr>
<tr>
<td>Input VSWR</td>
<td>( VSWR_i )</td>
<td>( V_{DD}=3.0V, V_{CONT}=2V, f=1.5GHz )</td>
<td>-</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Output VSWR</td>
<td>( VSWR_o )</td>
<td>( V_{DD}=3.0V, V_{CONT}=2V, f=1.5GHz )</td>
<td>-</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### ELECTRICAL CHARACTERISTICS 3

(PDC1.5GHz/PHS1.9GHz: Measured at TEST CIRCUIT 2)

(*T_a=25°C, Z_s=Z_l=50Ω*)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Frequency 1</td>
<td>freq1</td>
<td>$V_{DD}=3.0V$</td>
<td>1429</td>
<td>1441</td>
<td>1453</td>
<td>MHz</td>
</tr>
<tr>
<td>Operating Frequency 2</td>
<td>freq2</td>
<td>$V_{DD}=3.0V$</td>
<td>1800</td>
<td>1900</td>
<td>1920</td>
<td>MHz</td>
</tr>
<tr>
<td>Drain Voltage</td>
<td>$V_{DD}$</td>
<td></td>
<td>2.7</td>
<td>3.0</td>
<td>5.0</td>
<td>V</td>
</tr>
<tr>
<td>Operating Current</td>
<td>$I_{DD}$</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V, P_{out}=-10dBm$</td>
<td>-</td>
<td>10</td>
<td>13</td>
<td>mA</td>
</tr>
<tr>
<td>Small Signal Gain</td>
<td>Gain</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V, P_{sat}=-10dBm, f=1.5GHz$</td>
<td>15.5</td>
<td>18</td>
<td>21</td>
<td>dB</td>
</tr>
<tr>
<td>Gain Flatness 1</td>
<td>$G_{Sat1}$</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V, P_{in}=-25dBm, f=1429~1453MHz$</td>
<td>-</td>
<td>0.5</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>GainFlatness 2</td>
<td>$G_{Sat2}$</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V, P_{in}=-25dBm, f=1800~1920MHz$</td>
<td>-</td>
<td>0.5</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Gain Control Range</td>
<td>$G_{cont}$</td>
<td>$V_{DD}=3.0V, V_{CONT}=0.1~2.0V, P_{in}=-25dBm$</td>
<td>35</td>
<td>40</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Pout at 1dB Gain Compression point 1</td>
<td>$P_{-1dB1}$</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V, f=1429~1453MHz$</td>
<td>-</td>
<td>+1.5</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>Pout at 1dB Gain Compression point 2</td>
<td>$P_{-1dB2}$</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V, f=1800~1920MHz$</td>
<td>-</td>
<td>+1.0</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>Adjacent Channel Leakage Power 1 (PDC Regulation)</td>
<td>$P_{acp1}$</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V, P_{out}=-10dBm, f=1441MHz$</td>
<td>-</td>
<td>-68</td>
<td>-</td>
<td>dBc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>offset=50kHz, $P_{in}; \pi/4$ DQPSK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjacent Channel Leakage Power 2 (PDC Regulation)</td>
<td>$P_{acp2}$</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V, P_{out}=-10dBm, f=1900MHz$</td>
<td>-</td>
<td>-70</td>
<td>-</td>
<td>dBc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>offset=50kHz, $P_{in}; \pi/4$ DQPSK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input VSWR</td>
<td>VSWR_i</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V$</td>
<td>-</td>
<td>1.8</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Output VSWR</td>
<td>VSWR_o</td>
<td>$V_{DD}=3.0V, V_{CONT}=2V$</td>
<td>-</td>
<td>1.5</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
TYPICAL CHARACTERISTICS 1 (Wide Band: Measured on TEST CIRCUIT 1)

S21, S11, S22, S12 vs. FREQUENCY
(V_{DD}=3V, V_{cont}=2V)

GAIN vs. FREQUENCY
(V_{DD}=3V)

GAIN, NF vs. FREQUENCY
(V_{DD}=3V, V_{cont}=2V)

GAIN, NF vs. FREQUENCY
(V_{DD}=4.5V, V_{cont}=3V)

INPUT VSWR vs. FREQUENCY
(V_{DD}=3V)

OUTPUT VSWR vs. FREQUENCY
(V_{DD}=3V)
TYPICAL CHARACTERISTICS 1 (Wide Band: Measured on TEST CIRCUIT 1)

**I\(_{DD}\) vs. \(V_{DD}\)**

\(V_{cont} = V_{DD} - 1V\)

**GAIN, \(I_{DD}\) vs. Vcont (Variable Gain)**

\(V_{DD} = 3V, P_{in} = 25dBm\)

**OUTPUT POWER, \(I_{DD}\) vs. INPUT POWER**

\(V_{DD} = 3V, V_{cont} = 2V, f = 1.5GHz\)

**OUTPUT POWER, \(I_{DD}\) vs. INPUT POWER**

\(V_{DD} = 3V, V_{cont} = 2V, f = 2.5GHz\)

**GAIN vs. Vcont**

\(f = 1.5GHz\)

**GAIN vs. Vcont**

\(f = 2.5GHz\)
TYPICAL CHARACTERISTICS 2 (PDC 800MHz Band: Measured on TEST CIRCUIT 2)

**GAIN vs. FREQUENCY**

- Gain vs. Frequency for different voltages: $V_{dd}=3V$.
- Frequency range: 0.5 to 3 GHz.

**GAIN vs. $V_{cont}$**

- Gain vs. Control Voltage for $V_{dd}=3V$, $f=938MHz$.
- Control Voltage range: 0 to 3 V.

**INPUT VSWR vs. FREQUENCY**

- Input VSWR vs. Frequency for different voltages: $V_{dd}=3V$.
- Frequency range: 0.6 to 1.2 GHz.

**OUTPUT VSWR vs. FREQUENCY**

- Output VSWR vs. Frequency for different voltages: $V_{dd}=3V$.
- Frequency range: 0.6 to 1.2 GHz.

**OUTPUT POWER, $I_{dd}$ vs. INPUT POWER**

- Output Power vs. Input Power for $V_{dd}=3V$, $V_{cont}=2V$, $f=938MHz$.
- $I_{dd}$ vs. $P_{1dB}$ and $P_{2dB}$.

**ACP, RMS VECTOR ERROR vs. OUTPUT POWER**

- ACP vs. RMS Vector Error for $V_{dd}=3V$, $V_{cont}=2V$, $f=938MHz$, offset=50kHz.
**TYPICAL CHARACTERISTICS 2 (PDC 800MHz Band: Measured on TEST CIRCUIT 2)**

**ACP, RMS VECTOR ERROR vs. Vcont**

(V_{DD}=3V, Input Power=-25dBm, f=938MHz, offset=50kHz)

**GAIN vs. FREQUENCY**

(V_{DD}=3V)

**ACP, RMS VECTOR ERROR vs. Vcont**

(V_{DD}=3V, Output Power=-10dBm, f=938MHz, offset=50kHz)

**TYPICAL CHARACTERISTICS 3 (PDC1.5GHz/PHS1.9GHz Band: Measured on TEST CIRCUIT 2)**

**GAIN vs. FREQUENCY**

(V_{DD}=3V, f=1441MHz)

**INPUT VSWR vs. FREQUENCY**

(V_{DD}=3V)
TYPICAL CHARACTERISTICS 3 (PDC1.5GHz/PHS1.9GHz Band: Measured on TEST CIRCUIT 2)

OUTPUT VSWR vs. FREQUENCY
(VDD=3V)

OUTPUT POWER, Idd vs. INPUT POWER
(VDD=3V, Vcont=2V, f=1441MHz)

ACP, RMS VECTOR ERROR vs. OUTPUT POWER
(VDD=3V, Input Power=-25dBm, f=1441MHz, offset=600kHz)

ACP, RMS VECTOR ERROR vs. Vcont
(VDD=3V, Input Power=-25dBm, f=1441MHz, offset=50kHz)
TYPICAL CHARACTERISTICS 3 (PDC1.5GHz/PHS1.9GHz Band: Measured on TEST CIRCUIT 2)

ACP, RMS VECTOR ERROR vs. Vcont

(PDC1.5GHz, Output Power=-10dBm, f=1441MHz, offset=50kHz)

ACP, RMS VECTOR ERROR vs. Vcont

(PHS1.9GHz, Input Power=-25dBm, f=1.9GHz, offset=600kHz)
APPLICATION CIRCUIT

RF IN

Z_s=50Ω

Z_o=50Ω

AMP

ATT

AMP

RF OUT

Z_o=50Ω

Z_l=50Ω

Vdd

V_con
**TEST CIRCUIT1** (WIDE BAND)

![Circuit Diagram 1](image)

**TEST CIRCUIT2** (PDC 800MHz, PDC 1.5GHz, PHS 1.9GHz)

![Circuit Diagram 2](image)

*NOTE*

<table>
<thead>
<tr>
<th>Frequency</th>
<th>C1</th>
<th>L2</th>
<th>C2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDC 800MHz</td>
<td>100pF</td>
<td>10nH</td>
<td>100pF</td>
</tr>
<tr>
<td>PDC 1.5GHz/PHS 1.9GHz</td>
<td>10pF</td>
<td>1.5nH</td>
<td>10pF</td>
</tr>
</tbody>
</table>
RECOMMENDED PCB DESIGN

Notes:

[1] Following chip capacitors work as bypass capacitor, and should be connected to corresponding terminals and the ground plane as close as possible.
   ① C3
   ② C4
   ③ C5

[2] Following chip capacitors are necessary to block DC bias.
   ① C1
   ② C2

[3] Parts list

<table>
<thead>
<tr>
<th>Parts ID</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1~C5</td>
<td>MURATA GRM36 Series</td>
</tr>
<tr>
<td>L1~L2</td>
<td>TAIYO-YUDEN HK1608 Series</td>
</tr>
</tbody>
</table>
Cautions on using this product

This product contains Gallium-Arsenide (GaAs) which is a harmful material.
- Do NOT eat or put into mouth.
- Do NOT dispose in fire or break up this product.
- Do NOT chemically make gas or powder with this product.
- To waste this product, please obey the relating law of your country.

This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.

[CAUTION]
The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.